

System Monitoring: LLview

November 27, 2015 | Carsten Karbach and Julia Valder

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Part I: Overview

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Motivation

- Is my job running?
- When will it start?
- How is the current load?
- How is my job placed?

Id	Owner	Submitted	ST	PRU	Class	Running On
juqueen1c1.192822.0	curioni	11/7	11:22	I	50	systemall
juqueen1c1.192824.0	curioni	11/7	11:23	I	50	systemall
juqueen1c1.192825.0	curioni	11/7	11:23	I	50	systemall
juqueen1c1.192835.0	curioni	11/7	13:37	I	50	systemall
juqueen4c1.82115.0	hhh150	11/4	19:13	I	50	m016
juqueen1c1.191375.0	hdu180	11/4	23:25	I	50	m008
juqueen1c1.192826.0	jzam1159	11/7	11:27	I	50	m008
juqueen1c1.192844.0	jhp00902	11/7	14:00	I	50	m008
juqueen2c1.190024.0	pra08801	11/3	04:31	I	50	m004
juqueen4c1.81936.0	jas1304	11/3	09:49	I	50	m004
juqueen4c1.81937.0	jas1304	11/3	09:49	I	50	m004
juqueen4c1.81938.0	jas1304	11/3	09:49	I	50	m004
juqueen4c1.81939.0	jas1304	11/3	09:50	I	50	m004
juqueen2c1.190675.0	jzam0420	11/5	13:42	I	50	m004
juqueen1c1.190354.10	fwu081	11/3	12:22	I	50	m002
juqueen2c1.190857.0	jiff4605	11/6	10:50	I	50	m002
juqueen2c1.190971.0	hhh073	11/7	10:11	I	50	m002
juqueen2c1.190972.0	grs30007	11/7	10:12	I	50	m002
juqueen3c1.79205.0	jink33009	11/7	11:56	I	50	m002
juqueen1c1.192846.0	jzam0435	11/7	14:18	I	50	m002
juqueen4c1.80786.3	hbo273	10/28	11:49	I	50	m001
juqueen2c1.189769.2	hbo381	11/1	23:48	I	50	m001
juqueen1c1.190640.0	hch02r	11/4	07:03	I	50	m001
juqueen1c1.190643.0	hch02r	11/4	07:03	I	50	m001
juqueen1c1.190642.0	hch02r	11/4	07:03	I	50	m001
juqueen1c1.190641.0	hch02r	11/4	07:03	I	50	m001
juqueen1c1.190647.0	hch02r	11/4	07:03	I	50	m001
juqueen1c1.190646.0	hch02r	11/4	07:03	I	50	m001
juqueen1c1.190645.0	hch02r	11/4	07:03	I	50	m001
juqueen1c1.190644.0	hch02r	11/4	07:03	I	50	m001
juqueen1c1.190648.0	hch02r	11/4	07:03	I	50	m001
juqueen3c1.78904.7	jikp0501	11/5	09:39	I	50	m001
juqueen2c1.190615.0	hhh045	11/5	09:55	I	50	m001
juqueen2c1.190617.0	hhh045	11/5	09:58	I	50	m001
juqueen4c1.82192.0	hhh045	11/5	14:42	I	50	m001
juqueen4c1.82197.0	hhh045	11/5	15:48	I	50	m001
juqueen2c1.190713.0	jikp0403	11/5	16:27	I	50	m001
juqueen2c1.190715.0	jikp0403	11/5	16:35	I	50	m001
juqueen2c1.190716.0	jikp0403	11/5	16:41	I	50	m001
juqueen1c1.191700.0	talahde	11/5	16:47	I	50	m001
juqueen2c1.190718.0	jikp0403	11/5	16:46	I	50	m001
juqueen2c1.190723.0	jikp0403	11/5	16:56	I	50	m001
juqueen1c1.191701.0	talahde	11/5	16:59	I	50	m001
juqueen2c1.190725.0	jikp0403	11/5	17:11	I	50	m001

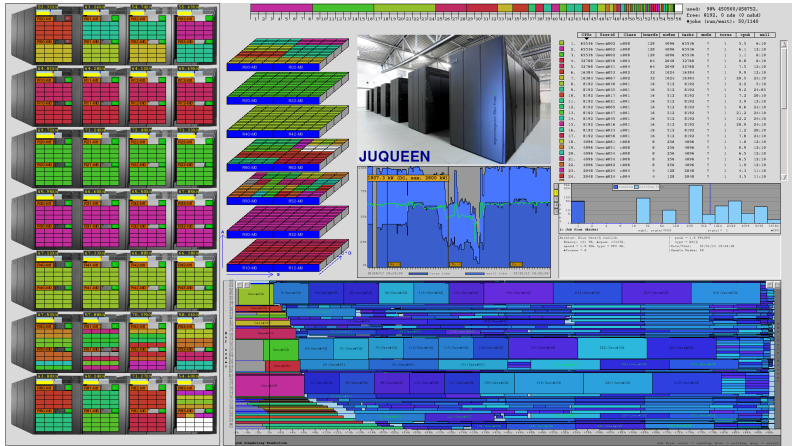
4/26/2015

Why system monitoring?

- For administrators
 - Global overview of system utilization
 - Throughput optimization
 - Batch system configuration optimization
 - Adaptive change of scheduling parameters
 - For users
 - Controlling own running and waiting jobs
 - Planning job submissions
 - Use of idling resources
- ⇒ LLview
- Compact display of all usage data in one window
 - Easy access to system's status data
 - Interactive display for linking information
 - Open Source (BSD-style)
 - Available for all JSC systems

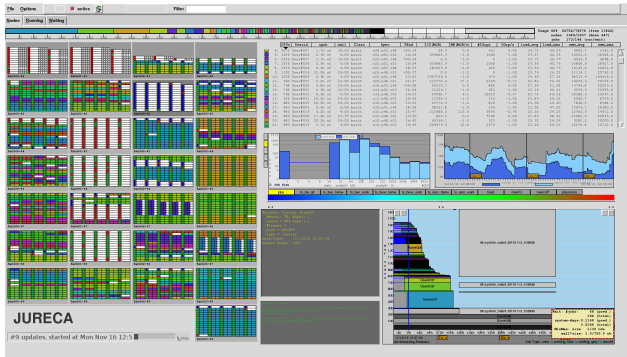
LLview

→ Visualizes supercomputer status on a single screen



Source: Screenshot LLview for JUQUEEN

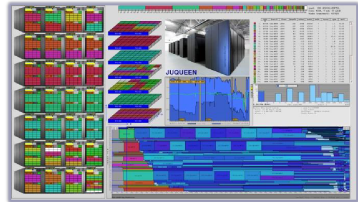
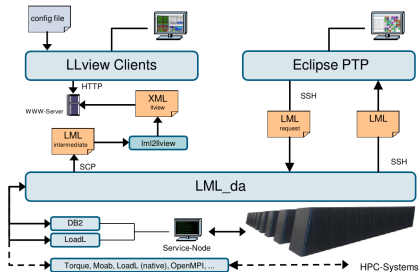
LLview Example: JURECA



- High fragmentation
- Heterogeneous
- Batch System: SLURM
- Ongoing development

Source: Screenshot LLview for JURECA

LLview Architecture

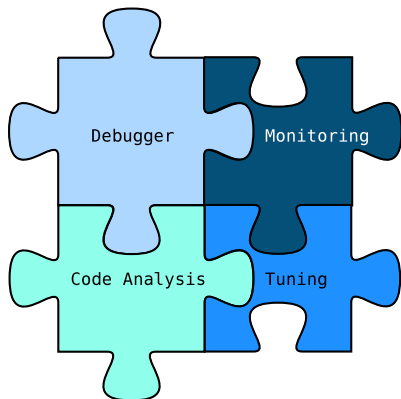


- Client-Server architecture, LML_da as backend
- Clients: Perl-Tk, PTP, Webinterface
- Platform independent: works on Windows, Mac and Linux
- Wide range of supported batch systems, minimal effort for extension
- Minor performance impact on monitored system, only **central batch** system is queried

PTP – Parallel Tools Platform

What is PTP?

- **IDE** for parallel application development
- Based on **Eclipse**
- **Open-source** project
- Developers:
IBM, U.Oregon, UTK,
Heidelberg University,
NCSA, UIUC, JSC, ...



- **JSC-PTP tutorials** → <http://www.fz-juelich.de/SharedDocs/Downloads/IAS/JSC/EN/PTP/JSCPTPJunqueen.html>
- **PTP Download** → <http://www.eclipse.org/downloads>, *Eclipse for Parallel Application Developers*

How to start the LLview client?

Option 1: via SSH

```
ssh -X karbach@jureca  
llview
```

Option 2: Webinterface

- Screenshots of LLview updated every minute
- Link: <https://llview.fz-juelich.de/LLweb/juqueen/Image.html>
- Access secured by JSC webservice accounts
 - register at dispatch
 - request access to LLview via `jsc-dispatch@fz-juelich.de`

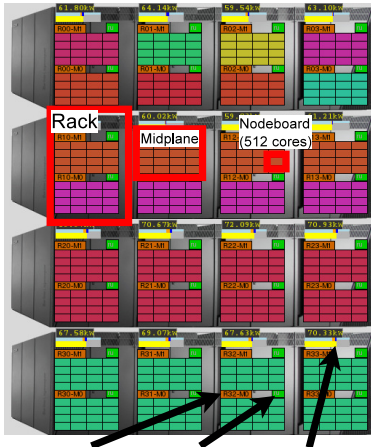
Option 3: Local installation

- Download and install the LLview client locally

Part II: Components

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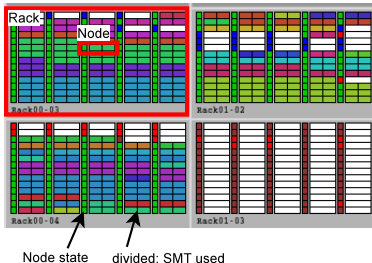
Node display



- Compute resources
- Job distribution
- White = Idle, Colored = running
- Node name
- Node status
- Level of detail

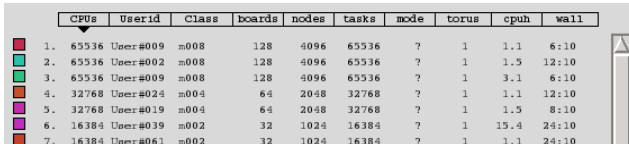
Midplane name Midplane state Rack power usage

Node display



- Compute resources
- Job distribution
- White = Idle, Colored = running
- Node name
- Node status
- Level of detail

Job list



	CPU	Userid	Class	boards	nodes	tasks	mode	torus	cpuh	wall
1.	65536	User#009	m008	128	4096	65536	?	1	1.1	6:10
2.	65536	User#002	m008	128	4096	65536	?	1	1.5	12:10
3.	65536	User#009	m008	128	4096	65536	?	1	3.1	6:10
4.	32768	User#024	m004	64	2048	32768	?	1	1.1	12:10
5.	32768	User#019	m004	64	2048	32768	?	1	1.5	8:10
6.	16384	User#039	m002	32	1024	16384	?	1	15.4	24:10
7.	16384	User#061	m002	32	1024	16384	?	1	1.1	24:10

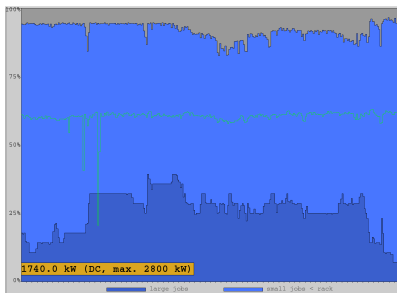
- List of running jobs
- Most important attributes per job
- Sort by clicking on the column header
- Identifying color next to each job entry

Usagebar



- Summary of system load
- Job size decreases from left to right
- White space shows idling resources
- Unit for JUQUEEN is midplanes,
for JURECA nodes

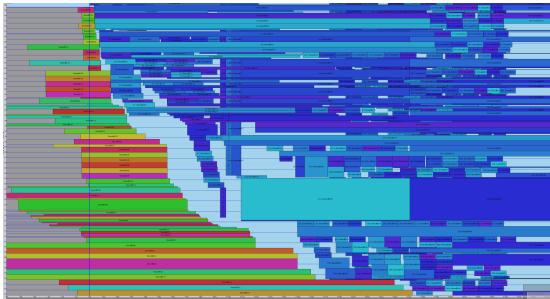
History



- 3-day load history
- Often divided into small and large jobs
JUQUEEN (1 midplane), JURECA (512 tasks)
- Mouse-Over for detailed information
- Green line for special history value
JUQUEEN (power)

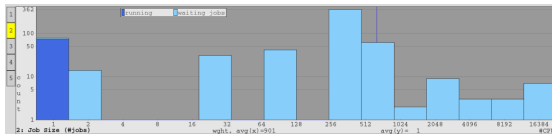
Prediction

- Scheduler prediction based on submitted jobs
- Wall clock limit as job duration
- Blue = predicted job, Colored = running jobs
- Each rectangle one job,
x-axis = time, y-axis = nodes/midplanes
- Use of idle times
- More transparent scheduling
- JUQUEEN: self-implemented, JURECA: use of SLURM's prediction



Statistics

- Statistic overview on system status
- Histograms on job size, wait time, queue load
- Highly configurable, define x-axis/y-axis domain, logarithmic/linear scale
- Overlaid diagrams for waiting/running jobs



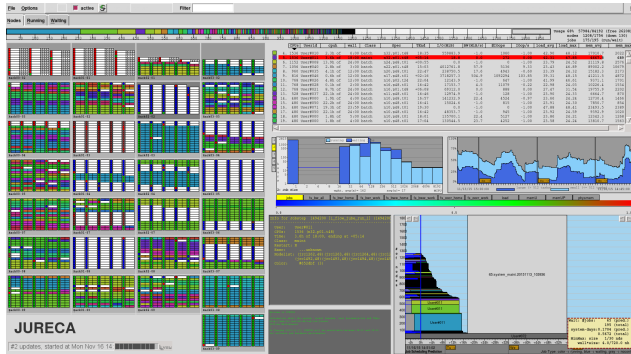
Infobox

```
Machine: Blue Gene/Q Juelich | peak = 5.9 PFLOPS  
Memory: 448 TB, #cpus: 458752, | type = BG/Q  
speed = 1.6 GHz type = PPC A2, | Date/Time: 04/02/13 17:58:02  
#frames = 28 | Usable Nodes: 56
```

- Shows details on the currently focused object
- Mouse-Over triggers to display detailed data on the focused job/node/system/diagram

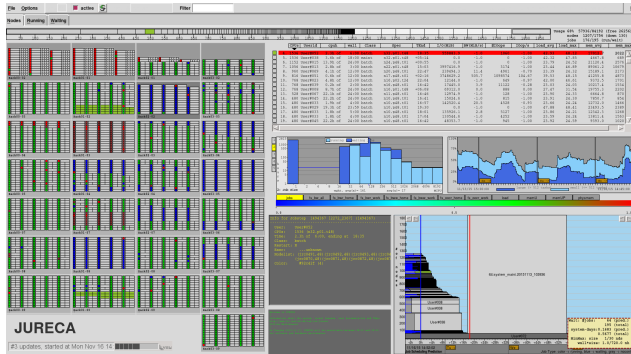
Interaction

- **Mouse-Over** jobs highlights job rectangles for the selected job in all components and shows details on the job in infobox



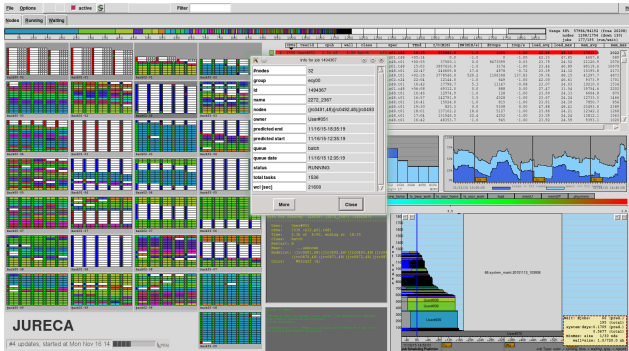
Interaction

- **Mouse-Over** jobs highlights job rectangles for the selected job in all components and shows details on the job in infobox
- **Mouse-Down** (Hold) removes color for all other jobs, only the selected job is colored



Interaction

- **Mouse-Over** jobs highlights job rectangles for the selected job in all components and shows details on the job in infobox
- **Mouse-Down** (Hold) removes color for all other jobs, only the selected job is colored
- **Double-Click** show job detail dialog
- Mouse interaction helps to link the information shown in all components



Part III: Customization

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LLview




- LLview is **highly customizable** due to numerous options
- Settings specific to HPC system type
- Start through option menu of main window or `Ctrl+o`
- Most options have **immediate effect** in the main window
- Some will become active at next start of LLview (e.g. *Data source* change)
- LLview layouts use **absolute** positioning
- You can use arrow keys to add/subtract one on numeric values
- Use Page up/Page down keys to add/subtract a bigger step on numeric values

LLview configuration files

Three configuration file locations (highest priority first):

- 1 anywhere on your file system passed to LLview with the `-rcfile` option
 - 2 local `.llview.rc` configuration file in current directory or in HOME directory of the user
 - 3 `llview.rc` in the installation directory of LLview. This file contains the system-wide settings
- Configuration files contain all LLview options
 - You can change them in any text editor or via the LLview Option window

LLview options

General	Elements	LocalData	WWW	llqxml	Info	Status	UsageBar	Nodes	NodeBox	LogView	Joblist	His
<div>  WWW: from Web-Server </div>												
<div> <div>data source</div> <div>  llqxml: Execute local command </div> <div>  LocalData: tar file on local machine </div> </div>												
<div> <div>verbose <input type="checkbox"/> on/off</div> <div>demo version <input type="checkbox"/> on/off</div> <div>show +/- buttons <input type="checkbox"/> on/off</div> </div>												
<div> <div>Node selection regexp</div> <div>.*</div> <div> Anonymise user names for demonstration purposes. LLview restart required </div> </div>												
<div> <div>Job selection regexp (uid)</div> <div>^bgldiag</div> </div>												
<div> <div>RC <input checked="" type="checkbox"/> on/off</div> <div>RC_id</div> <div>juqueen</div> </div>												
<div> <div>Height</div> <div>640</div> <div>Width</div> <div>1220</div> </div>												
<div> <div>Height (Lines)</div> <div>61</div> </div>												
<div> <div>Geometry</div> <div></div> </div>												
<div> <div>Canvas Color</div> <div>grey85</div> </div>												
<div> <div>Update <input checked="" type="checkbox"/> on/off</div> <div>Update time (s)</div> <div>60</div> </div>												
<div> <div>auto play <input type="checkbox"/> on/off</div> <div>Autoplay Step (s)</div> <div>5</div> </div>												
<div> <div>Mark Color</div> <div>red</div> </div>												
<div> <div>Mark Width</div> <div>2</div> </div>												
<div> <div>version</div> <div>1.3</div> </div>												
<div> <div>no frame for mainwindow <input type="checkbox"/> on/off</div> <div>notimestate <input type="checkbox"/> on/off</div> </div>												

General Options

- *General* options for the main window
- Choose your preferred data source (*Web-Server*, *LocalData* or *local command*)
- *demo version*: anonymise usernames (for public display)
- *Job selection regexp*: filtering jobs by regular expressions
- Customize *Height* and *Width* of the main window
- *Canvas Color*: background, *Mark Color*: color for marking job in job list
- Choose time until next update
- *auto play* lets LLview mark different jobs automatically (for public display)

LLview Element options

General	Elements	LocalData	WWW	llqxml	Info	Status	UsageBar	Nodes	NodeBox	Lc
!!! changes on following options have only effect !!! !!! after save options and restart llview !!!										
show usage bar					<input checked="" type="checkbox"/> on/off	show nodes				
show joblist					<input checked="" type="checkbox"/> on/off	show running				
show waiting					<input checked="" type="checkbox"/> on/off	show graph				
show histogram					<input checked="" type="checkbox"/> on/off	show status				
show info					<input checked="" type="checkbox"/> on/off	show history				
show partition (BG)					<input type="checkbox"/> on/off	show reservations (BG)				
show prediction of usage					<input checked="" type="checkbox"/> on/off	show usage history				

- Choose, which Elements to show
- For end users: components like *joblist*, *info*, *nodes* and *prediction* etc.
- Changes take effect after **restarting** LLview

LLview Node options

General	Elements	LocalData	WWW	llxml	Info	Status	UsageBar	Nodes	NodeBox	LogView	Joblist	Histogram	File
X position	5	Y position	0	Height	640	Width	380						
Box Margin West	0	Box Margin East	-2	Box Margin North	-0	Box Margin South	-7						
Draw border	<input checked="" type="checkbox"/> on/off	Debug Layout	<input type="checkbox"/> on/off	BOX Color	grey85								
Twin View	<input type="checkbox"/> on/off	View Type	Both	Selector X	655	Selector Y	16	max select #	3				
Usagebars	<input type="checkbox"/> on/off												
Node attr.	jobs	min	-	max	-								
colmap	<input type="checkbox"/> on/off	colmap x	0	colmap y	0	colmap width	30	colmap height	100				
col map vertical	<input checked="" type="checkbox"/> on/off	number format	%2.1f	colmap unit	<input type="checkbox"/> on/off	colmap scale factor	0.6						
colmap font	Monospace												
use User Layout	<input type="checkbox"/> on/off	Layout	(rack:R00-M0,R00-M1,width=70,height=330,order=down,stack=down,frame=yes,fill=grey50,bor										
Racks per Row	4	Rack gap X	11	Rack gap Y	11	named racks	<input type="checkbox"/> on/off						
Font (State)	-*-Helvetica-Medium-R-Normal--*-80-*-*-*-*												
Font (Action)	-*-Helvetica-Medium-R-Normal--*-100-*-*-*-*												
Font (NodeName)	-*-Helvetica-Medium-R-Normal--*-80-*-*-*-*												
Font (SiteName)	-*-Helvetica-Bold-R-Normal--*-240-*-*-*-*												
Font (Power)	-adobe-Courier-Medium-R-Normal--08-100-75												
show INOUT	<input type="checkbox"/> on/off	InOut pos. X	858	InOut pos. Y	419								
show Logo	<input type="checkbox"/> on/off	Logo pos. X	9	Logo pos. Y	0	Image name	lib/images/JUGENE_logo						
show Site Name	<input checked="" type="checkbox"/> on/off	Name pos. X	622	Name pos. Y	389								
Color	darkblue	Site Name	JUQUEEN										

Node Options

- Customize *Height*, *Width* and *Margins* of the node display
- Logical node view available for BG systems e.g. JUQUEEN \Rightarrow *Twin View* places adjacent midplanes next to each other in torus network
- Options for the *Twin View* are available in a new option subfolder \Rightarrow *Log View*
- *Node attr.*: show scalar data e.g. temperature or power usage
- Show logo or site name

LLview Histogram options

General	Elements	LocalData	WWW	llqxml	Info	Status	UsageBar	Nodes	NodeBox	LogView	Joblist	Histogram
<div> <div>Diagram 1</div> <div>Diagram 2</div> <div>Diagram 3</div> <div>Diagram 4</div> <div>Diagram 5</div> <div>Diagram 6</div> <div>Diagram 7</div> <div>Diagram 8</div> </div>												
<div> <div>diagram title</div> <div>Job Wait Time</div> </div>												
<div> <div>Jobselection</div> <div>ALLSEP</div> <div>Legend offset X</div> <div>180</div> <div>Legend offset Y</div> <div>2</div> </div>												
<div> <div>X-Axis data</div> <div>QUEUE TIME</div> </div>												
<div> <div>Y-Axis data</div> <div>COUNT</div> </div>												
<div> <div>Stepwidth (xdata)</div> <div>12</div> </div>												
<div> <div>Log x data</div> <div>LINEAR</div> </div>												
<div> <div>Log y data</div> <div>LOG10</div> </div>												
<div> <div>Format X</div> <div>day</div> <div>Format Y</div> <div>%3d</div> </div>												
<div> <div>Format AVG X</div> <div>day</div> <div>Format AVG Y</div> <div>%3d</div> </div>												
<div> <div>Fill Color</div> <div>darkblue</div> <div>Fill Color (Run)</div> <div>darkgreen</div> </div>												
<div>Global Option for all diagrams</div>												
<div> <div>Display Diagram</div> <div>Diagram 1</div> </div>												
<div> <div># diagrams</div> <div>5</div> <div>autoplay delay</div> <div>10</div> </div>												
<div> <div>posx</div> <div>244</div> <div>posy</div> <div>587</div> </div>												
<div> <div>Height</div> <div>179</div> <div>Width</div> <div>300</div> </div>												
<div> <div>Font</div> <div>-adobe-courier-medium-r-normal-*-*60-*-*-*</div> </div>												
<div> <div>BoldFont</div> <div>-adobe-courier-bold-r-normal-*-*70-*-*-*</div> </div>												
<div> <div>number Font</div> <div>-*Courier-Medium-R-Normal-*-*120-*-*-*</div> </div>												
<div> <div>Padding left</div> <div>30</div> <div>Padding right</div> <div>50</div> <div>Padding bottom</div> <div>25</div> <div>Padding top</div> <div>15</div> </div>												
<div> <div>Button width</div> <div>10</div> <div>Legend width</div> <div>135</div> <div>Legend height</div> <div>15</div> </div>												

Histogram Options

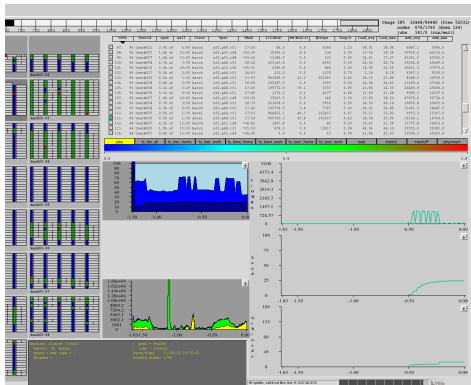
- Each histogram shows distribution for a single job attribute, e.g. waiting time
- You can configure up to 8 histograms
- Jobs are grouped into discrete classes, y-axis shows count of jobs in each class
- Y-axis may also show number of CPUs, CPU hours or job duration
- Scaling may be linear or logarithmic
- *Auto play* is available for public display

Recent and future development

- Load, Memory and I/O **profile per job**
- **Annotations** for adding texts, images and markers at any location on LLview display
- **Release** expected at the end of 2015

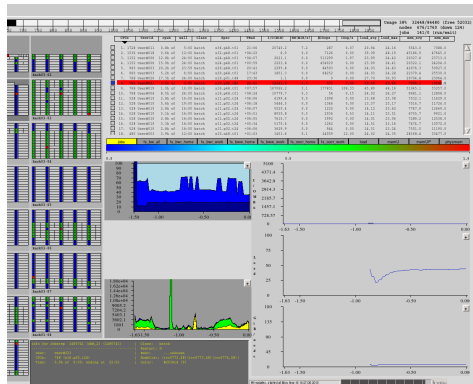


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Contact

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- **LLview** → <http://www.fz-juelich.de/jsc/llview>
- **JSC-PTP tutorials** →
<http://www.fz-juelich.de/SharedDocs/Downloads/IAS/JSC/EN/PTP/JSCPTPJunqueen.html>
- **PTP Download** → <http://www.eclipse.org/downloads>